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ABSTRACT

A severely physically disabled (quadriplegic) third grade student with high average intellectual abilities was fitted with a computer system adapted for maximum student independence. A scanner, the face of which is an integrated circuit board, was constructed to allow accessibility to the computer by a single switch operated by the student's tongue. (Details of the scanner construction and adaptation are given.) Among difficulties encountered with the system were staff anxiety, space limitations, the need for back-up equipment, the requirement of keeping abreast of new ideas, unanticipated psychological factors, and other unknown complications (such as heat buildup). Sources of equipment, periodicals, and information on organizations are listed. (CL)

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A COMPUTER APPLICATION FOR SEVERELY HANDICAPPED CHILDREN

A paper based on a presentation at the CEC/CASE Technology in Special Education Conference, Reno, Nevada.

by

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January 28, 1984

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ABSTRACT

This case study describes the successful mainstreaming of a severely physically disabled third grade student. The student is a C-1 level spinal cord injured quadriplegic. He requires 24 hour per day nursing services. The educational program developed utilizes a scanner to interface the student with a computer. The scanner allows the student to use either a single or proportional (direct selection) switch opperated by his tongue. Customized and off the shelf software is used to allow the student to perform academic tasks.

PRESENTING PROBLEM

The receiving school district was notified by Children's Orthopedic Hospital and the parents that a severely physically disabled student would be enrolling within the district. The student was a six-year-old boy with intellectual abilities within the high average range. He was also described as a C-1 spinal cord injured quadriplegic.

The student has no sensation below the face and is unable to move his head. A neck brace and headrest are required on his wheelchair. He is respirator dependent, which fits into the frame of his custom-designed chair. The chair, which is motorized, is operated by the student through the use of a tongue controller. He requires 24 hour per day nursing supervision. The student can speak, but requires a voice amplifier in order to be heard adequately in school and social settings.

The recommendations from Children's Orthopedic Hospital included a computer to be placed in the classroom to allow the student to perform homework assignments and also to be used as a motivator. To interface the student with the computer, a handicapped typing program by Rocky Mountain Software was used. It was found that this program (which displays a keyboard on the monitor and allows the student to scan and select using a single switch hooked into the Apple game paddles) worked if the only task required was writing. There was no control over off the shelf software.

It became obvious that a new interface that allowed the student to control the computer with little assistance from other people was needed. The new equipment would have to be as user friendly as possible and adaptable to a wide variety of tasks. Our research and trials came up with the following system.

SYSTEM DEVELOPED

The heart of the system is an Apple II Plus computer with a disk drive. The computer has 48K of memory. It has been modified with an Enhancer II Board by Videx, which allows upper and lower case letters to be generated from the keyboard. The monitor is a color screen that uses white characters on a black background. The other peripheral used is a printer hooked into the computer to print out a hard copy of the work done by the student.

To interface the student with the computer, a Tetra Scan II built by Zygo Industries is used. The scanner is an integrated circuit board that allows accessability to the Apple using a single or proportional switch. The Tetra Scan is invisible to the computer, which allows the keyboard to be used at the same time. It opperates in two modes; scanning the board, or by direct selection.

The board, or face of the scanner, is divided into eight rows of eight columns. Each space has a letter, number, sign, word, or function that is compatible with the keyboard on the Apple. The spaces also have lights that go on to signify when the space is ready to be accessed.

In the scanning mode, each row is lit up and turned off one at a time. When the last row is lit, the sequence starts over again. If the student wanted to enter the letter "X", he/she would wait for the row in which the "X" is located to be lit up. When lit, the student presses the switch. The row sequence then stops and the column sequence begins, with each space in turn being lit. The student waits for the "X" space to light up and presses the switch. The letter "X" is then entered into the computer.

In the alternate mode, the scan sequence does not operate, rather, only one light is lit. The single light can be driven anywhere around the board by the use of a proportional controler, such as a joystick. When the space is reached, the student lets the joystick go to the neutral position and the light remains flashing in that space. After a short pause, the character in that space is entered into the computer. Scan/directed speed, and delay time for changing an answer before input are adjustable by dials on the board.

The scanner has built into it 4K of memory that can be user-programmed to change the position of the characters on the board. These changes can be saved on one of the three different levels available to be programmed. As well as changing character position, each space can be programmed with up to 240 characters per space, including control and return functions. To illustrate this, the following contains 220 characters, including returns, and could be fit in one space with room for 20 more characters:

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PLEASE CONTACT US FOR MORE INFORMATION

Spaces can also be programmed with blends like; the, which is the start of they, them, and part of the word other. All of these programming strategies help to increase speed of output. Placement of the programmed areas should correspond with cues,e.g., put the above message in the C space for the C in Cliff.

The system is placed in a regular third grade classroom as the student receives no direct special education assistance. It is placed in the back of the room to allow the student easy access. The monitor and the scanner are placed on a hospital bed table so the height can be adjusted as the student grows. The computer, disk drive, and printer are placed on a table next to the monitor. The student is interfaced with the computer through a single throw tounge-activated switch which mounts to his wheelchair on a gooseneck adapter.

DIFFICULTIES ENCOUNTERED

As the system has been used it was found there are problems that arise that have no specific answers. It is interesting to note that other people who are working along the same lines are finding similar problems. Some items of interest are:

STAFF ANXIETY It is scary enough to have a student like the one above in the classroom, but even more anxiety provoking when a computer is also introduced. What we see happening is that the computer is used primarily for the above student and not with other children in the class. This reduces the cost effectiveness greatly. To overcome this problem, software designed for this age level was introduced but the situation remains the same. Our inservice time of 20-25 hours may need to be increased.

SPACE LIMITATIONS Most normal classrooms are used with a premium on extra space. The severely-handicapped student puts a tax on the limited space that does exist. Provisions for ramps, and equipment such as oxygen tanks and back-up respirators take large areas. The placement of computer equipment also poses special problems. One of the hardest, especially in older schools, is finding enough electrical outlets to plug in the equipment.

BACK-UP EQUIPMENT Due to the nature of tasks completed by the student, if the original equipment goes down, the student is left in the position of having others do his work for him. When looked at through cost effectiveness, having a specialized piece of equipment standing by is not appropriate. It is recommended that in dealing with specialized computer equipment, find the most reputable dealers . Service contracts are very important.

KEEPING TRACK OF NEW IDEAS This is probably the hardest area to manage. New systems develop monthly. To manage this task requires constant reading and review of the literature. Please see the SOURCES section.

PSYCHOLOGICAL FACTORS Due to the newness of computers and severely-handicapped users, this area has little information available. The need for further research is apparent. In our case a unique problem arose. Up until the time we started the program, our student was with an adult in mostly one-to-one situations. With the computer, the student suddenly became independent, reducing the adult contact time. We noticed that the computer started having several problems that were eventually traced to the student "tripping" the computer. When all parties, including the student, were brought on about this, the problem stopped.

UKNOWN FACTORS This is the most interesting area of concern which includes things such as; chalk dust building up on the circuit boards of the computer, static electricity shorting out the programs, and heat building up due to keeping hardware as compact as possible. To deal with the chalk dust, we covered the computer when not in use and had the janitor vacuum the keyboard. We armored all cables and sprayed the carpets with static neutralizer to elimate the shorting problem. To combat heat, we installed a fan on the computer and spread the equipment out.

SOURCES

EQUIPMENT

Prentke Romich Company, 8769 Township Rd 513, Shreve, Ohio 44676-9421. Suppliers of electronic equipment for handicapped individuals. Very informative catalog.

Zygo Industries, Inc., P.O. Box 1008, Portland, OR 97207-1008. Suppliers of electronic equipment such as TETRA SCAN II. Very good personal service.

PERIODICALS

The Computing Teacher, Dept. of Computer & Information Science, University of Oregon, Eugene, Oregon 97403. One of the standards in the area of computers in schools.

Classroom Computer News, Intentional Educations, Inc., 341 Mt. Auburn St., Watertown, MA 02172. They have a good selection of software/hardware vendors as well as practical articles on classroom computer use.

THE JOURNAL, P.O. Box 364, Arlington, MA 02174. A very comprehensive periodical that covers a wide variety of topics related to computers. A very good selection for readers to request information.

ORGANIZATIONS

Maplewood Center Project, Contact: Judy McDonald, 4614 First Ave. NE, Seattle, WA 98105. This center has computers integrated in there severely physically handicapped program. A good source of information/products.

Trace Center, University of Wisconsin-Madison, 314 Waisman Center, 1500 Highland Ave., Madison, WI 53706. A very good source for information on computers and handicapped individuals.

R & T Center, Dept. of Rehab Medicine, University of Washington, Seattle, WA 98195. This department is working on Morse code input for computers as well as other projects.

Institute of Electical & Electronics Engineers, INC., Publishers of the very fine John Hopkins' Personal Computing to Aid the Handicapped.